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Initial investigations into two different approaches for applying autonomous ground vehicle technology to the vehicle convoying application are described. A minimal capability system that would maintain desired speed and vehicle spacing while a human driver provided steering control could improve convoy performance and provide positive control at night and in inclement weather, but would not reduce driver manpower requirements. Such a system could be implemented in a modular and relatively low cost manner. A more advanced system would eliminate the human driver in following vehicles and reduce manpower requirements for the transportation of supplies. This technology could also be used to aid in the deployment of teleoperated vehicles in a battlefield environment. The needs, requirements, and several proposed solutions for such an Attachable Robotic Convoy Capability (ARCC) System are discussed. Included are a discussion of sensors, actuators, computers, communications, control systems, and safety issues. This advanced robotic convoy system will provide a much greater capability, but will be more difficult and expensive to implement.

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Paper 852-31, Session 7 *(see page 29)*

Guidance of a Mobile Robot Using an Omnidirectional Vision Navigation System

Sung Jun Oh and Ernest L. Hall (Center for Robotics Research, University of Cincinnati, Cincinnati, OH 45221-0072)

Navigation and visually guided control are key topics in the design of a mobile robot. Omnidirectional vision using a very wide angle or fish eye lens provides a hemispherical view at a single instant that permits target location without mechanical scanning. The inherent image distortion with this view is easily corrected to provide accurate position determination for navigation and control.

The purpose of this paper is to present an analysis and experimental results relating to the accuracy, resolution, errors, and other imaging characteristics of the omnivision system. These experiments were conducted using a prototype sensor, laboratory vision processor, and an industrial robot for controlled motion. Multiple target detection and tracking have been performed. The significance of this work is that the experimental information provides a greater understanding of the dynamic omnivision characteristics and give insights into evaluating and improving the prototype sensor. This sensor system is currently being developed for a robot lawn mower.

Paper 852-32, Session 7 *(see page 29)*

Nurse's Aide and Housekeeping Mobile Robot for use in the Nursing Home Workplace

John A. Sines, ADL Robots

The large nursing home market has several natural characteristics which make it a good applications area for robotics. The environment is already robot accessible and the work functions require large quantities of low skilled services on a daily basis. In the near future, a commercial opportunity for the practical application of robots is emerging in the delivery of housekeeping services in the nursing home environment. The robot systems will assist in food tray delivery, material handling, and security, and will perform activities such as changing a resident's table side drinking water twice a day, and taking out the trash. The housekeeping work functions will generate cost savings of approximately $22,000 per year, at a cost of $6,000 per year.

Technical system challenges center around the artificial intelligence required for the robot to map its own location within the facility, to find objects, and to avoid obstacles, and the development of an energy efficient mechanical lifting system. The long engineering and licensing cycles (7 to 12 years) required to bring this type of product to market make it difficult to raise capital for such a venture.

Paper 852-34, Session 7 *(see page 29)*

Prolog-Based World Models for Mobile Robot Navigation

Mark B. Kadonoff (Denning Mobile Robotics, Inc., 21 Cummings Park, Woburn, MA 01801)

Model-based reasoning provides a powerful tool for intelligent robotics applications. Current mobile robot world models have been of limited use due to the static spatial description they maintain of their environment. Experience gained from configuring mobile security robots for several real-world applications has pointed out the difficulty of designing a general purpose feature-based world model.

An alternative approach is to develop an extensible world model that can be easily tailored for a particular environment. Features can be added or removed interpretively from the model as necessary. Navigation and position estimation algorithms are developed for each class of features. The applications engineer then declares features appropriate to a particular installation.

This paper will describe a prototype system constructed using a Prolog interpreter augmented with C-based sensor and control primitives, controlling an indoor mobile security robot.

Paper 852-35, Session 7 *(see page 29)*

Development of an Electrical Flywheel for Surge Power Applications in Mobile Robots

David D. Wright (Unique Mobility, Inc., Englewood, CO 80110)

A flywheel can greatly extend the capabilities of mobile robots by increasing the power available to operate special equipment like transmitters, drills, manipulator arms, mobility augmenters, and etc. Surge power from a flywheel can increase the low but steady power available from fuel cell, RPG and solar sources by one or more orders of magnitude for short periods. The electromechanical design of a reliable, energy efficient and (relatively) low cost flywheel are given in this paper. Flywheels are reliable (in spite of having one moving part) and energy efficient compared to batteries. Flywheels can endure billions of charge/discharge cycles while few batteries live beyond one thousand cycles. Laboratory tests of a prototype flywheel rotor and separate tests of an actuator indicate that the combination of a high efficiency brushless motor/alternator and a laminated steel rotor operating in a compact, hermetically sealed container with only electrical input and output can overcome the inefficiencies generally associated with mechanically geared devices. Electrical output energy divided by electrical input energy (round trip efficiency) approaches 95% as the duty cycle approaches 100%.

Paper 852-36, Session 7 *(see page 29)*

Ground Vehicle Convoying

Douglas W. Gage (Naval Ocean Systems Center, San Diego, CA 92152), J. Bryan Pletta (Sandia Corporation, Albuquerque, NM 87185)

Initial investigations into two different approaches for applying autonomous ground vehicle technology to the vehicle convoying application are described. A minimal capability system that would maintain desired speed and vehicle spacing while a human driver provided steering control could improve convoy performance and provide positive control at night and in inclement weather, but would not reduce driver manpower requirements. Such a system could be implemented in a modular and relatively low cost manner. A more advanced system would eliminate the human driver in following vehicles and reduce manpower requirements for the transportation of supplies. This technology could also be used to aid in the deployment of teleoperated vehicles in a battlefield environment. The needs, requirements, and several proposed solutions for such an Attachable Robotic Convoy Capability (ARCC) System are discussed. Included are a discussion of sensors, actuators, computers, communications, control systems, and safety issues. This advanced robotic convoy system will provide a much greater capability, but will be more difficult and expensive to implement.